

Geoengineering and Climate Change: An Assessment using EdGCM

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Background and Motivation

Research Questions

1. What are the effects of increasing concentration of greenhouse gases in the Earth's climate system using RCP8.5 emission scenario?
2. How does the geoengineering approach compare with the RCP8.5 scenario to counteract climate change?

Motivations

- Analyzing the most likely climate change scenario we are headed for in the future if we don't lower greenhouse gas emissions
- Explore the potentials of reversing global warming using geoengineering solutions

Geoengineering

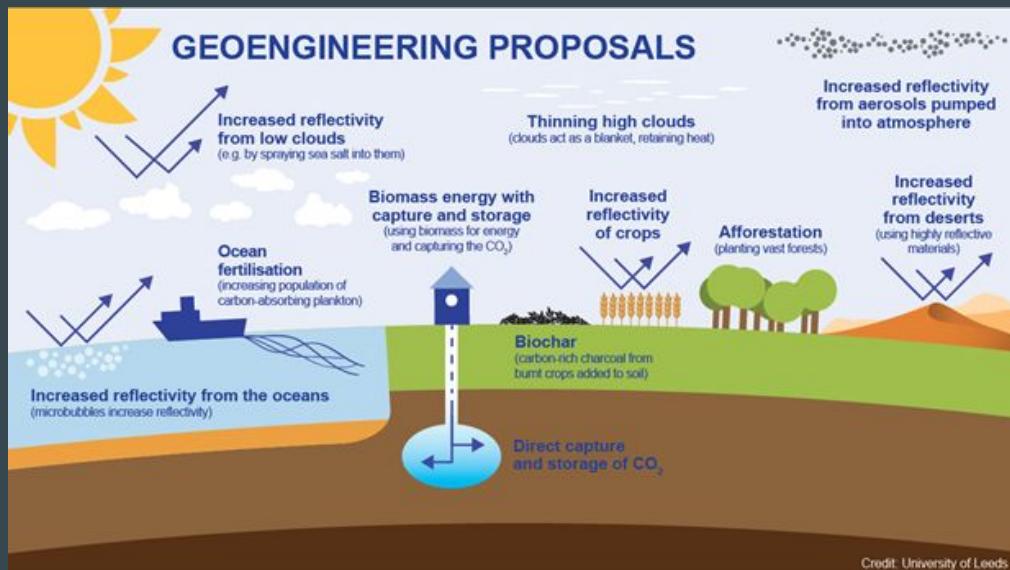
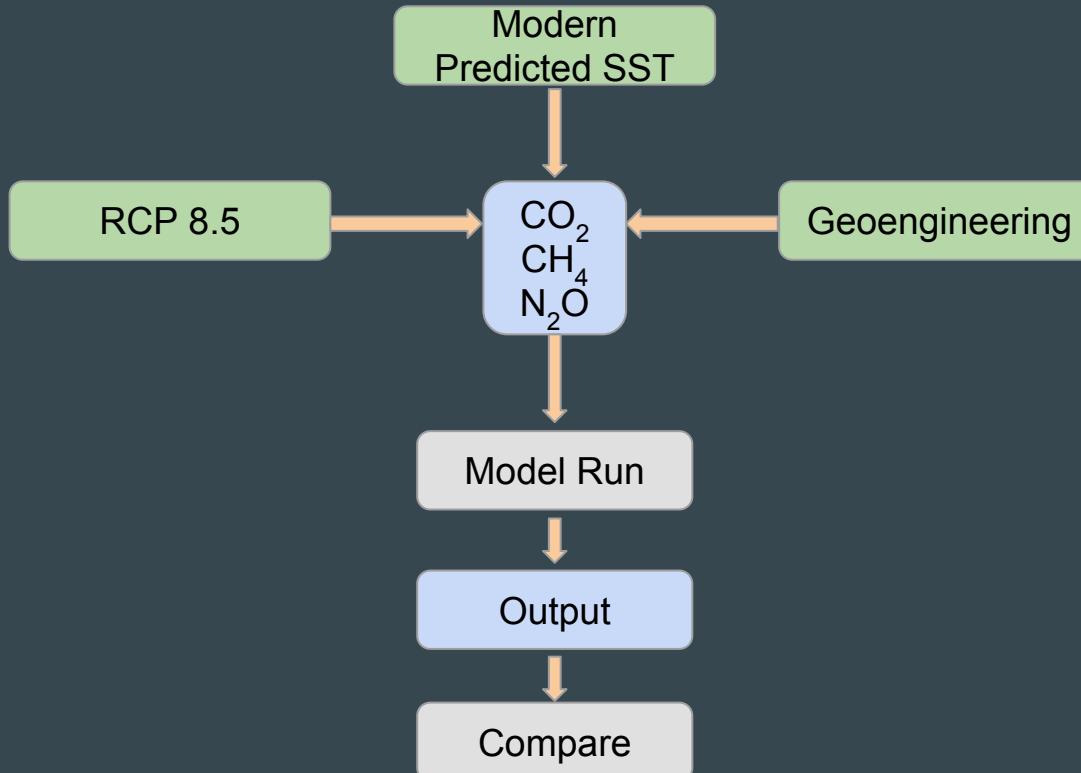


Figure courtesy: https://www.leeds.ac.uk/news/article/3631/geoengineering_our_climate_is_not_a_quick_fix

Methodology



Period 1: 2000 to 2050
Period 2: 2051 to 2100

Model Setup: RCP 8.5 and Geoengineering

Table 1. Initial values and trends for RCP 8.5 and Geoengineering forcings.

	RCP 8.5	Geoengineering
Initial CO2/Trends	368 ppm/ 0.65 %/yr Exp.	368 ppm/ 0.65%/yr Exp. for Period 1 -0.33%/yr Exp. for Period 2
Initial N2O/Trends	0.3157 ppm/ 0.0016%/yr Lin.	0.3157 ppm/ no change
Initial CH4/Trends	1.735 ppm/ 0.42 %/yr Exp.	1.735 ppm/ 0.42 %/yr Exp. for Period 1 -0.21 %/yr Exp. for Period 2
Initial CFC11	0.2646 ppt	0.2646 ppt
Initial CFC12	0.5367 ppt	0.5367 ppt

Forcing Trends

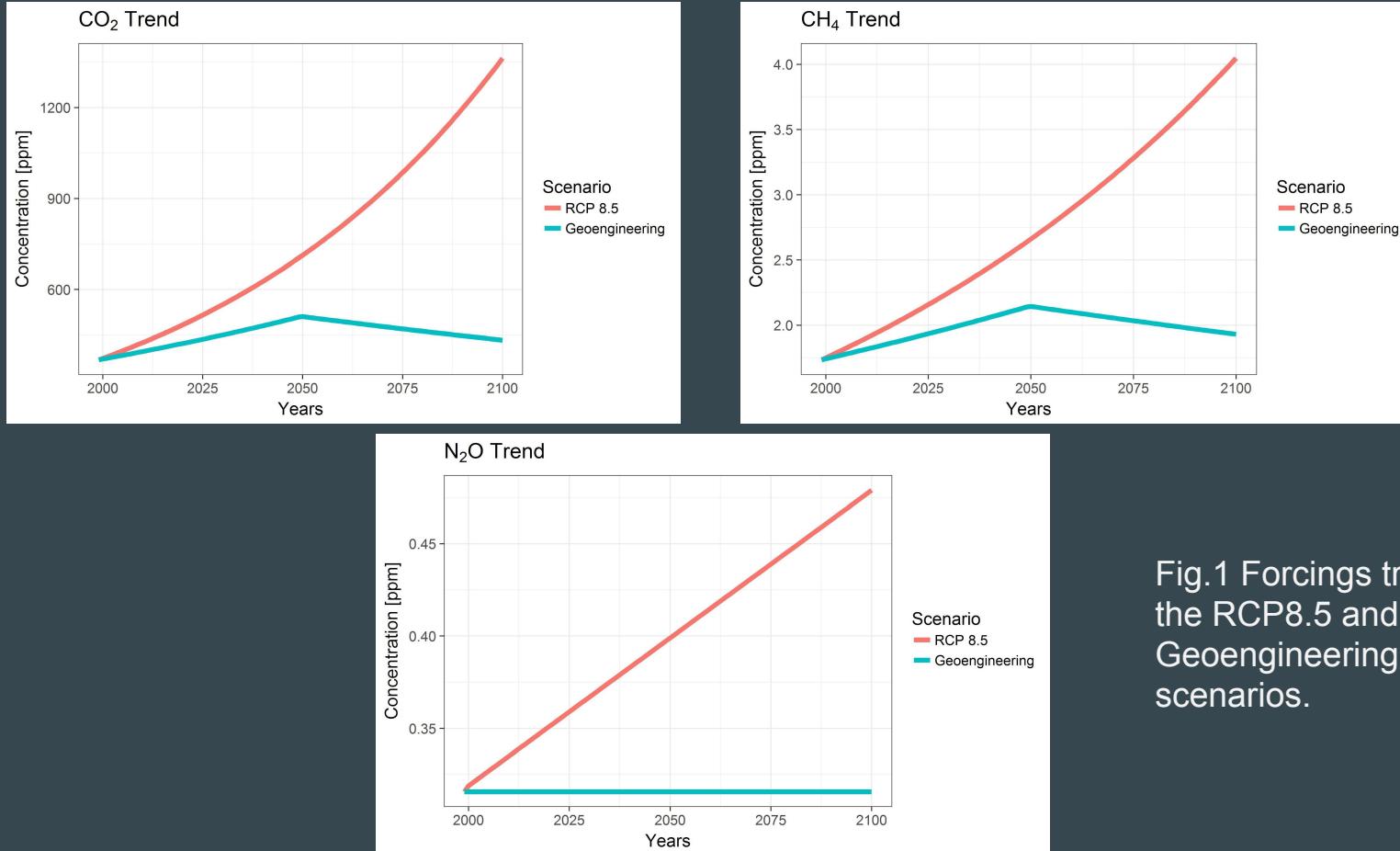


Fig.1 Forcings trends in the RCP8.5 and Geoengineering scenarios.

Global Average Timeseries

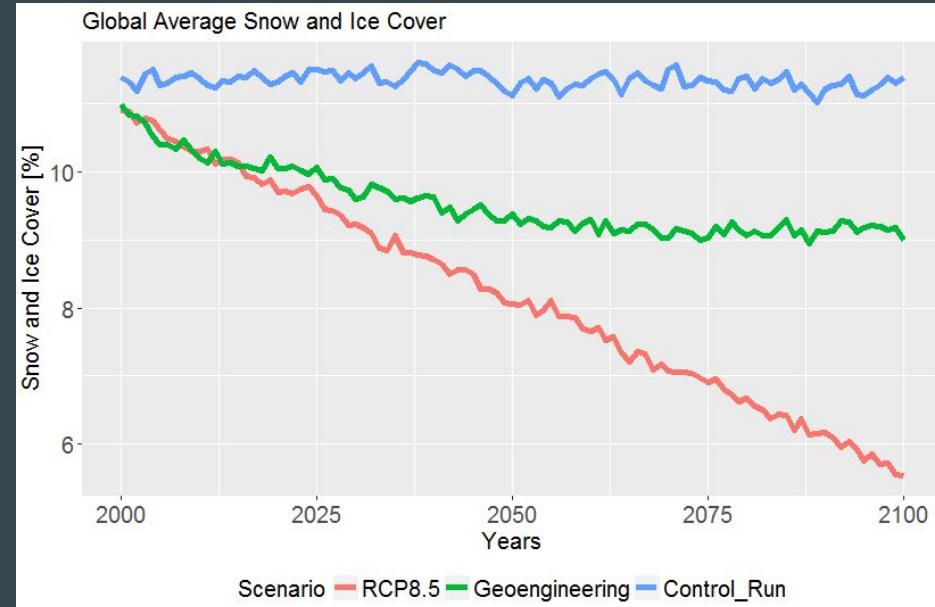
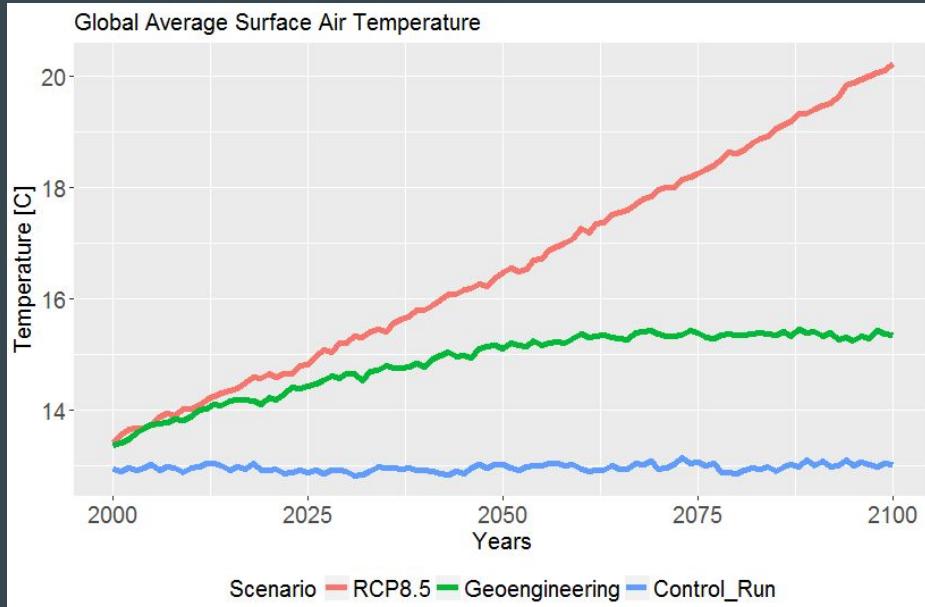


Fig.2 Comparison of global average surface air temperature and snow and ice cover timeseries.

Surface Air Temperature

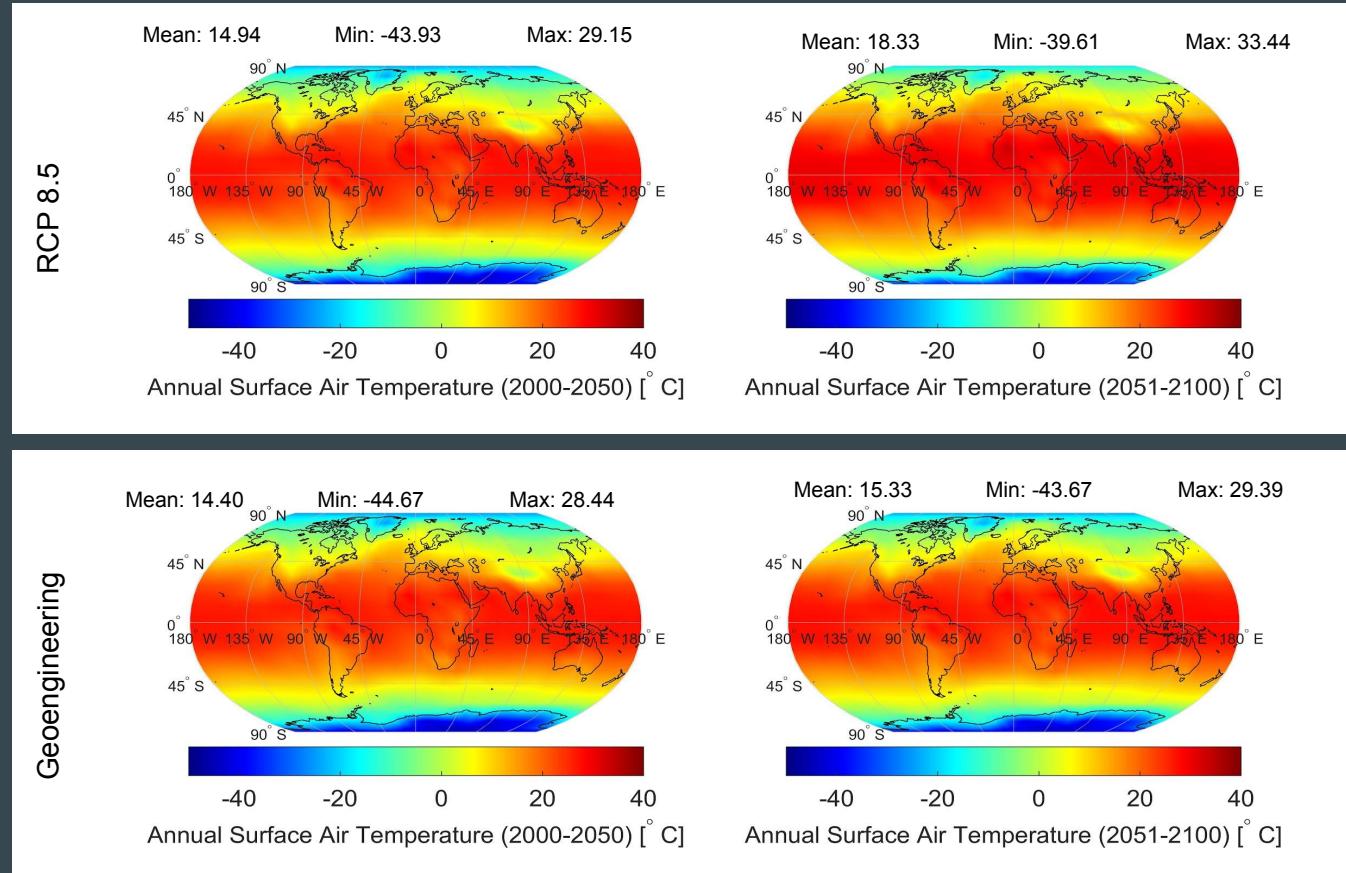


Fig.3 Average Annual Surface Air Temperature for RCP 8.5 and Geoengineering over Period 1 and 2.

Precipitation

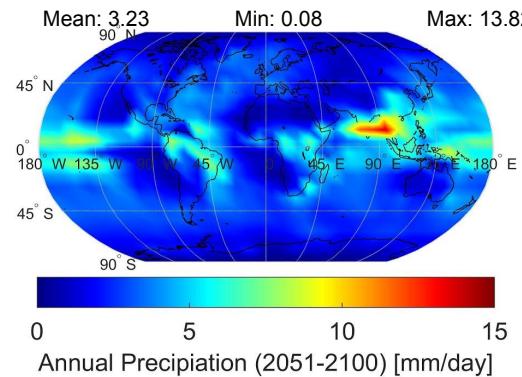
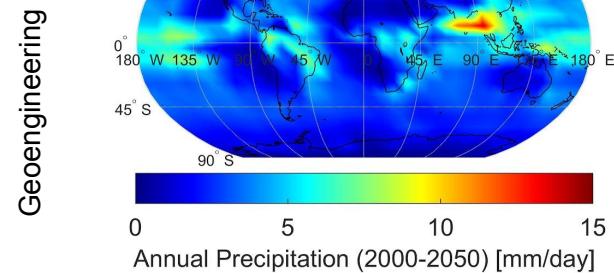
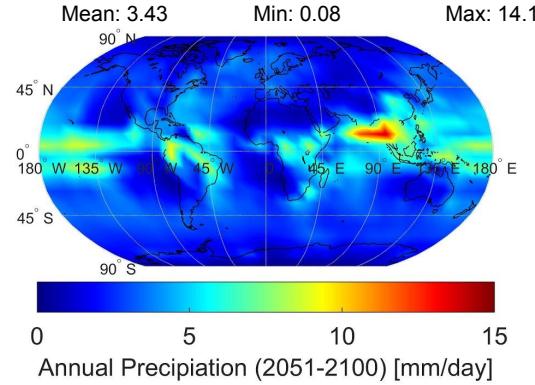
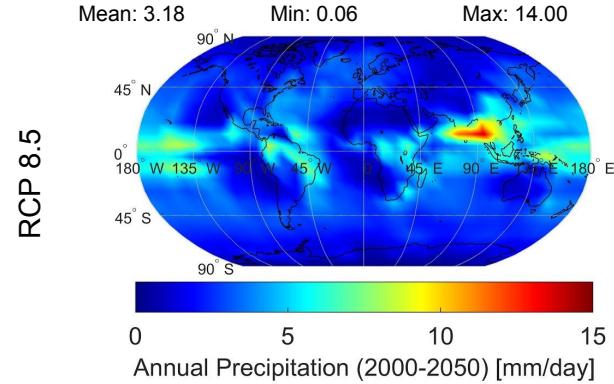


Fig.4 Average Annual Precipitation for RCP 8.5 and Geoengineering over Period 1 and 2.

SST

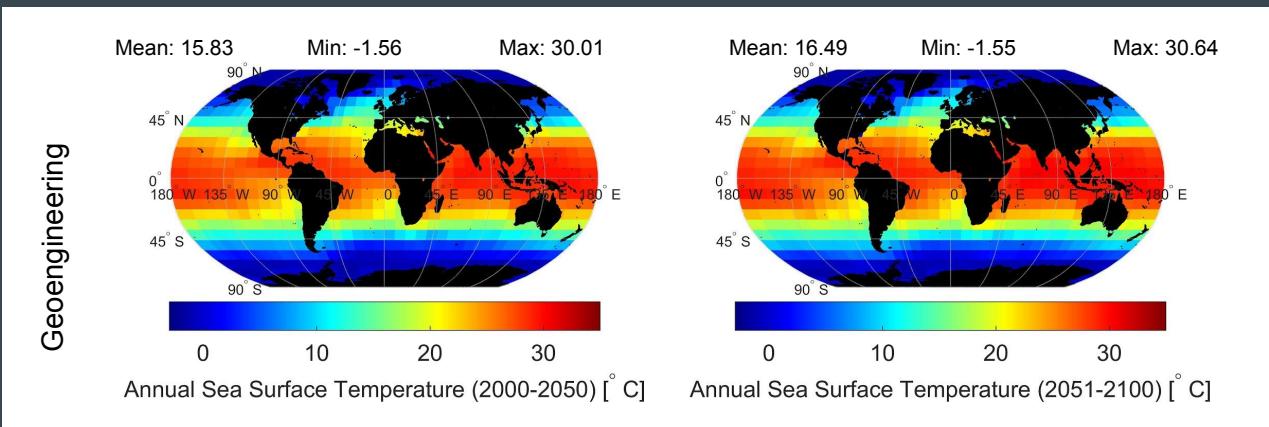
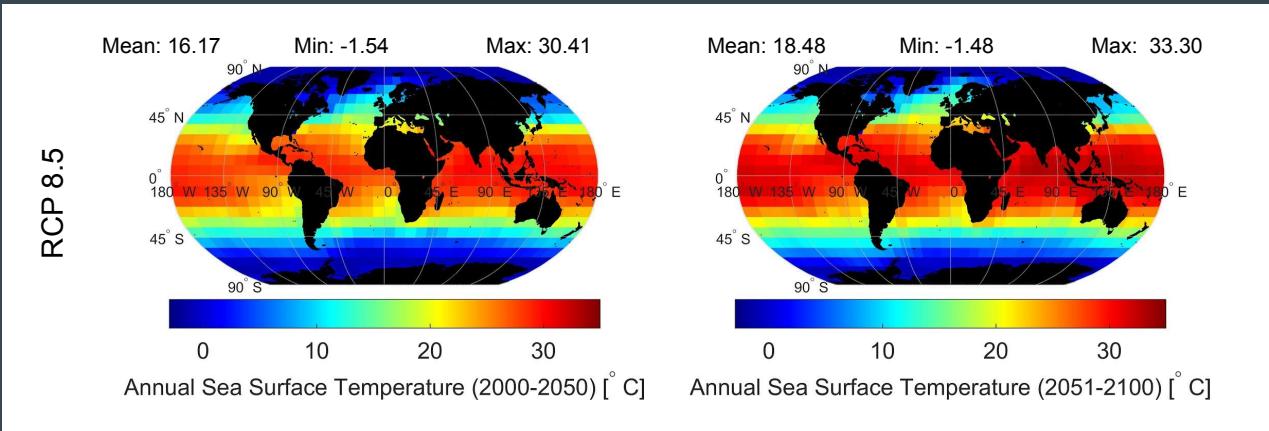


Fig.5 Average Annual Sea Surface Temperature for RCP 8.5 and Geoengineering over Period 1 and 2.

Snow and Ice Cover

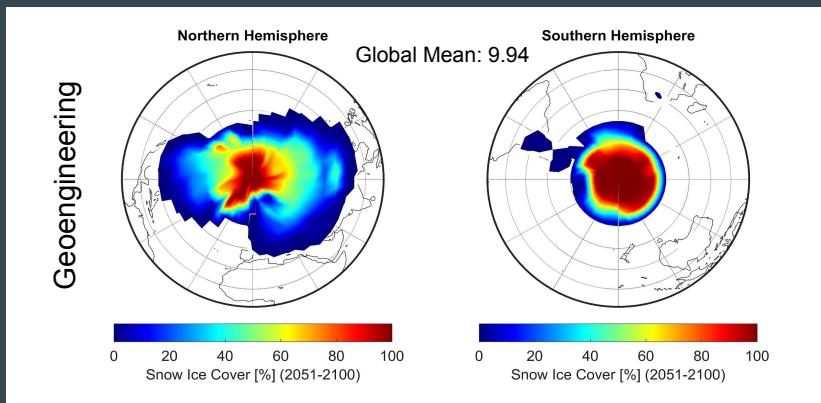
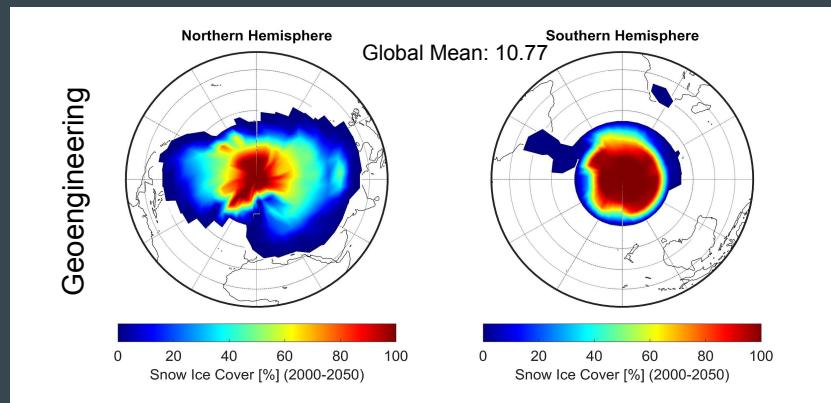
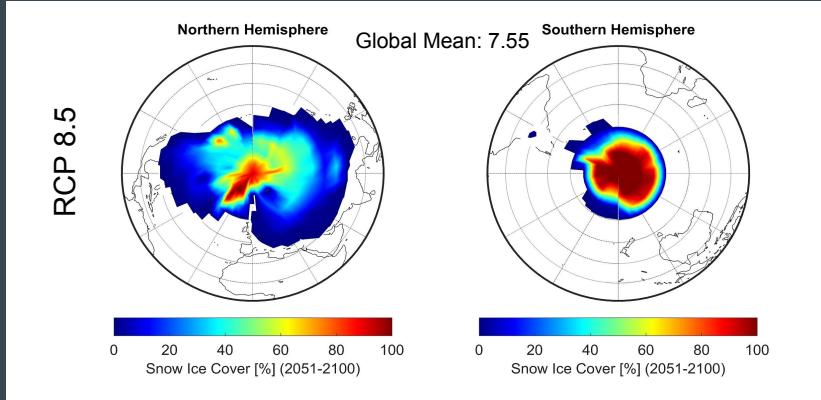
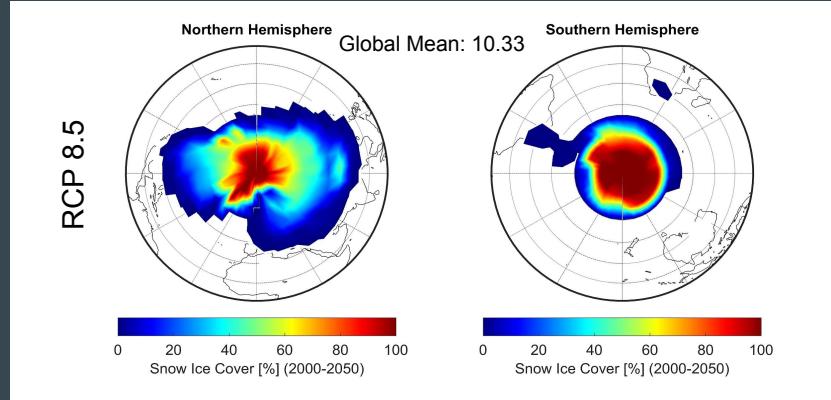


Fig.6 Average Annual Snow and Ice Cover for RCP 8.5 and Geoengineering over Period 1 and 2.

Surface Air Temperature Difference

Period 2 - Period 1

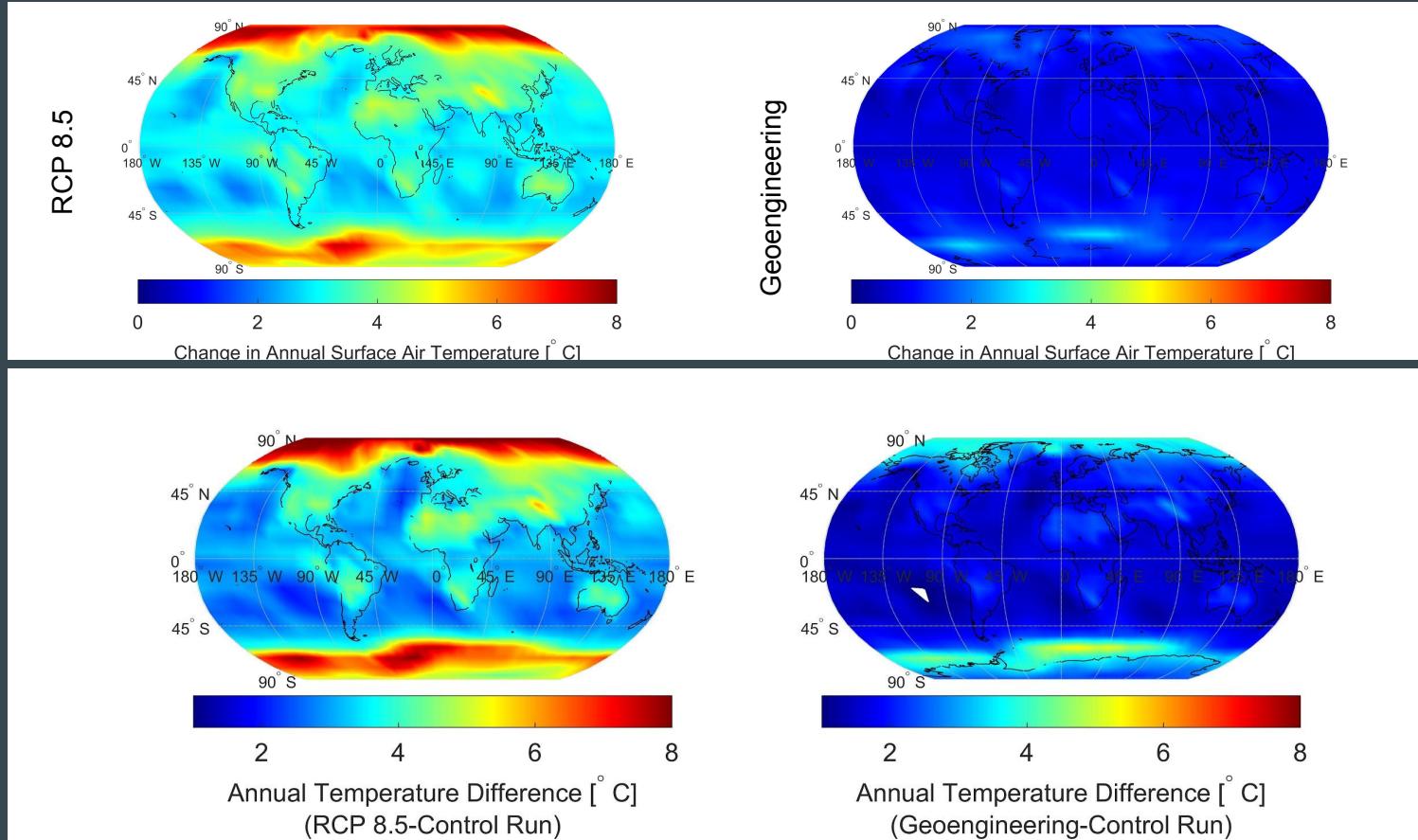
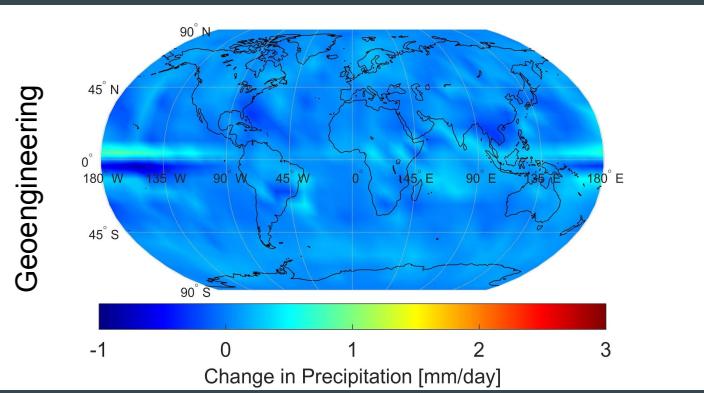
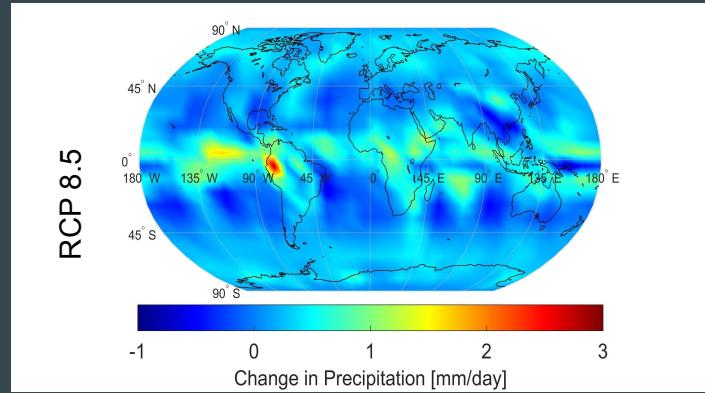


Fig.7 Average Annual Surface Air Temperature differences for RCP 8.5 and Geoengineering from Period 2 to 1 and with control run for the entire period.

Precipitation Difference

Period 2 - Period 1



Scenario - Control Run

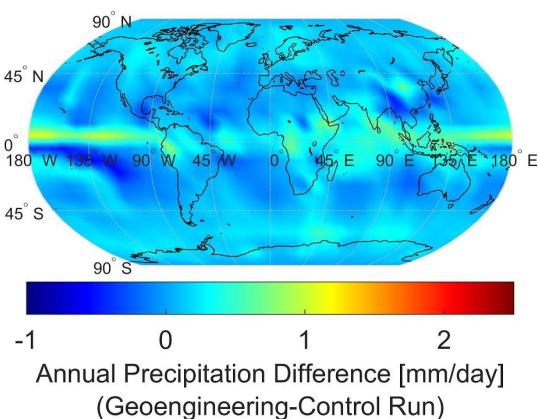
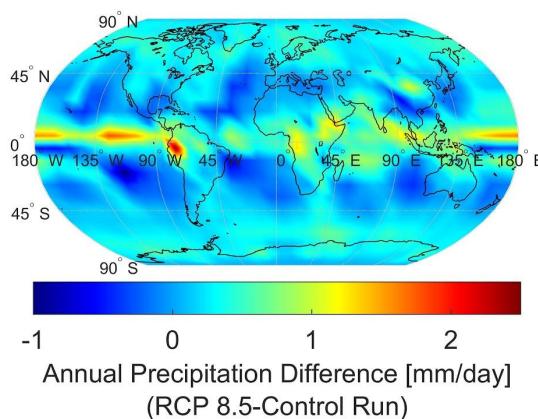
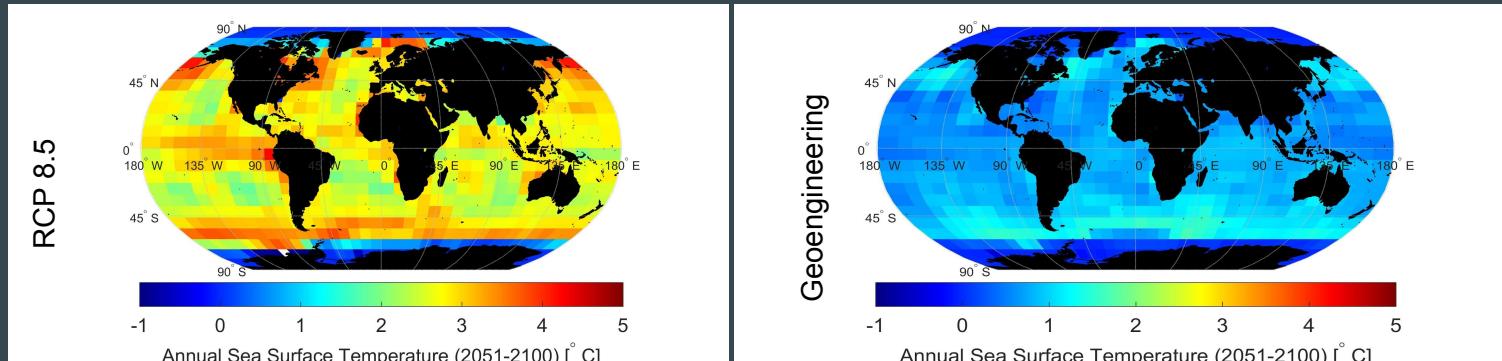


Fig.8 Average Annual Precipitation differences for RCP 8.5 and Geoengineering from Period 2 to 1 and with control run for the entire period.

SST Difference

Period 2 - Period 1



Scenario - Control
Run

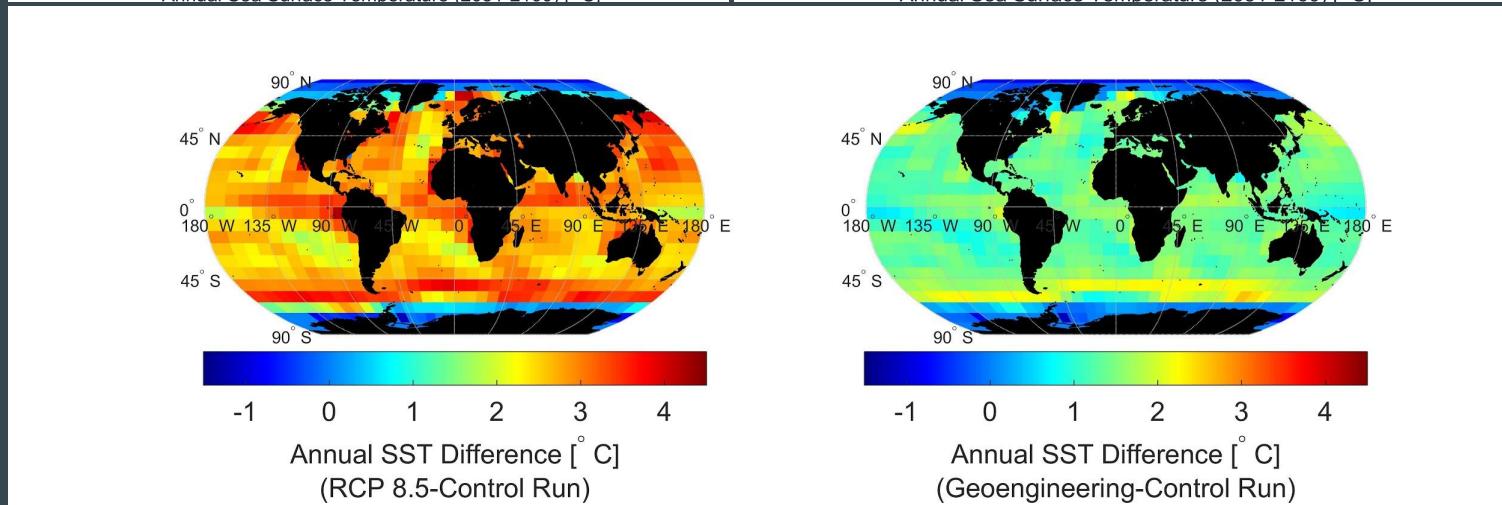


Fig.9 Average Annual Sea Surface Temperature differences for RCP 8.5 and Geoengineering from Period 2 to 1 and with control run for the entire period.

Snow and Ice Cover Difference

Period 2 - Period 1

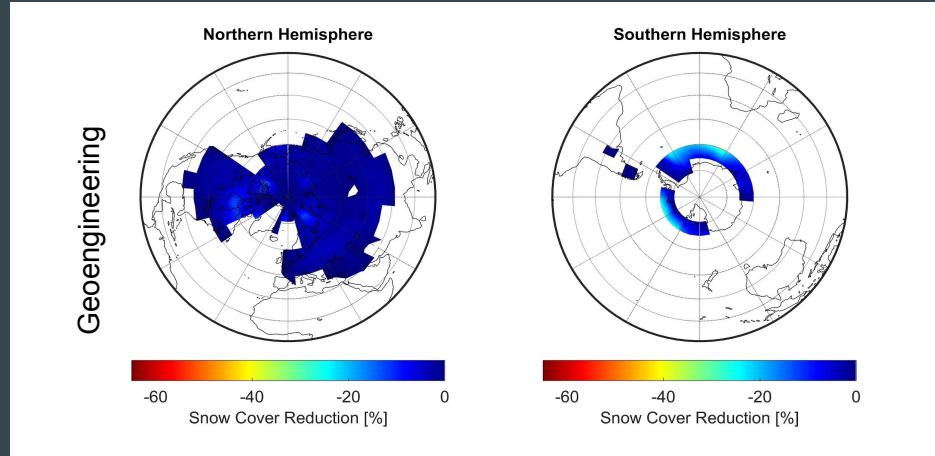
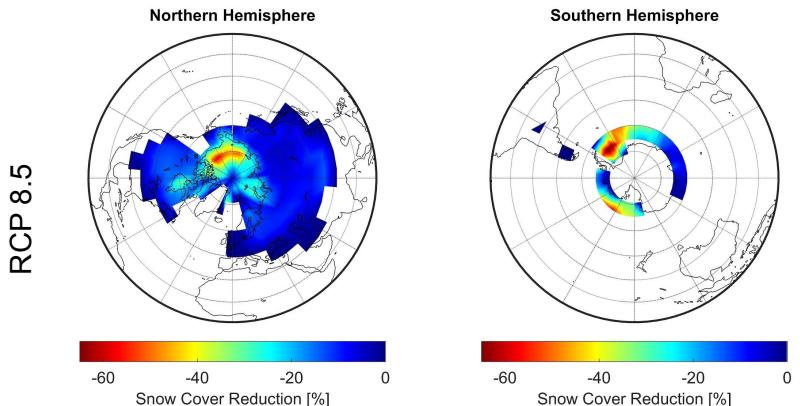


Fig.10 Average Annual Snow and Ice Cover differences for RCP 8.5 and Geoengineering from Period 2 to 1.

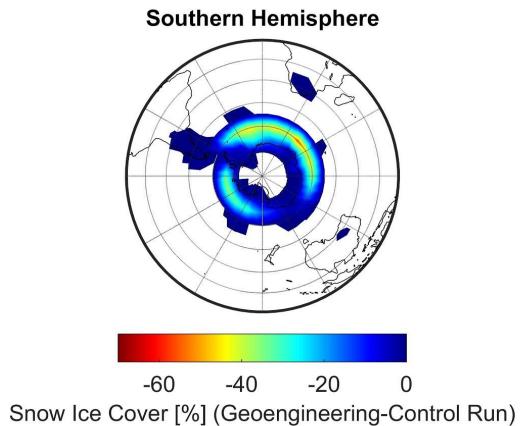
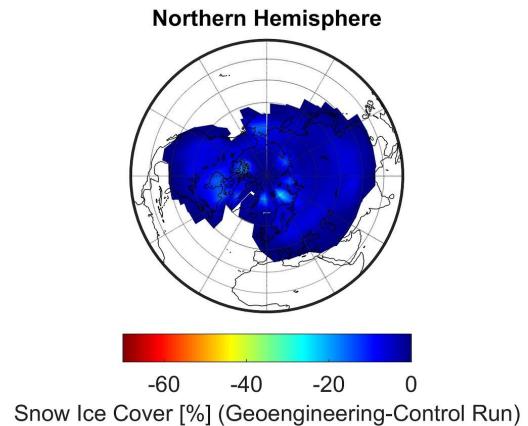
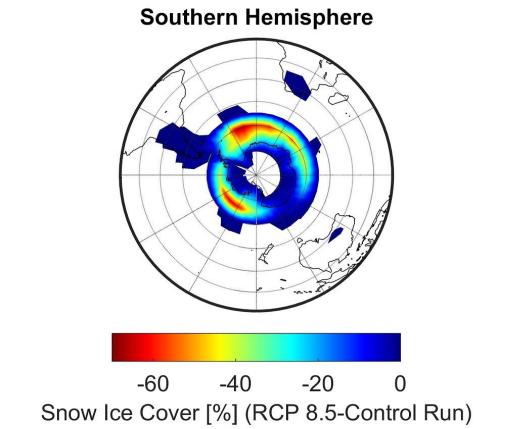
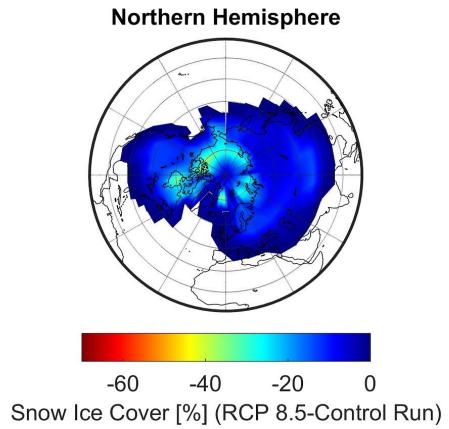


Fig.11 Average Annual Snow and Ice Cover differences for RCP 8.5 and Geoengineering with control run for the entire period.

Conclusion

Advantages

- Can easily be seen where our climate is headed in the most extreme scenario
- Regional hot spots can be easily identified
- Geoengineering scenario shows the potential for meeting climate goals (e.g. Paris Climate Agreement)

Disadvantages/Limitations

- This study does not consider socioeconomic factors from the RCP scenarios
- Model resolution is not high enough to identify changes in a particular region
- We are only running one model